Integrating composting into the life cycle assessment of palm oil production

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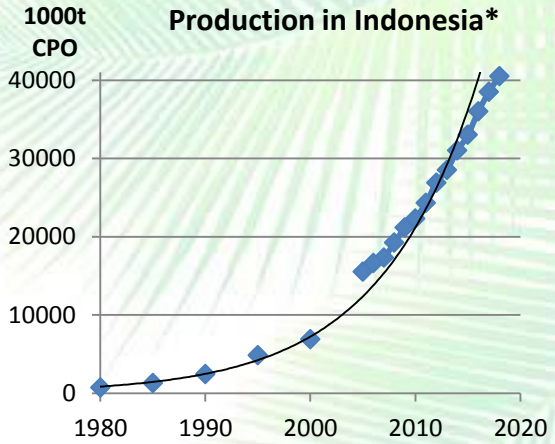
The challenge of sustainable palm oil production



Exponential increase of production in Indonesia.

Exponential land use change and environmental degradation.

Sustainability: long term balance between social/economical/ environmental

5 challenges in Indonesia:

1. Protecting primary forest, high conservation value areas and peatland
2. Reducing the environmental impact of existing plantations (water quality, soil quality, pesticides, GHG)
3. Closing the yield gap between smallholders and agro-industries
4. Building economically resilient territories (diversification, added value, self-reliance)
5. Building fair value chains (land ownership, working conditions)

*Source: Oil World

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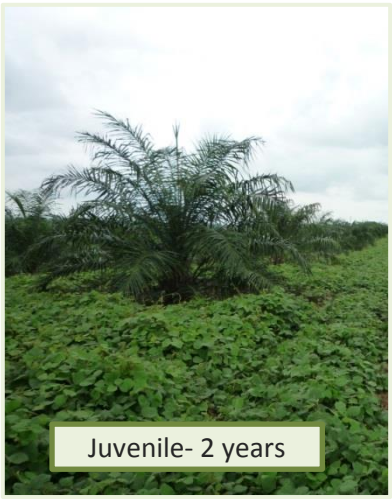
Different stages of the oil palm crop cycle

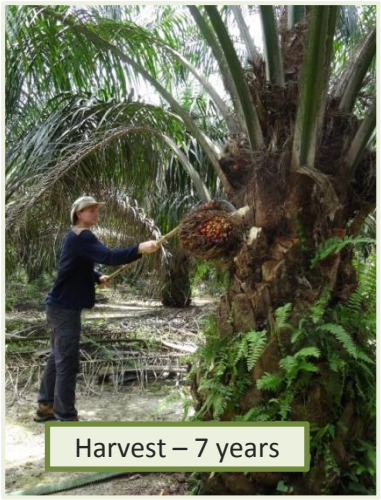

Pre-nursery

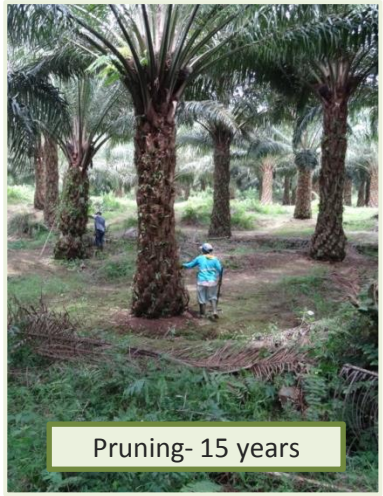
Nursery 5 months


Nursery 10 months


1 year after planting


Juvenile- 2 years


Harvest – 7 years


Pruning- 15 years


Harvest- 24 years

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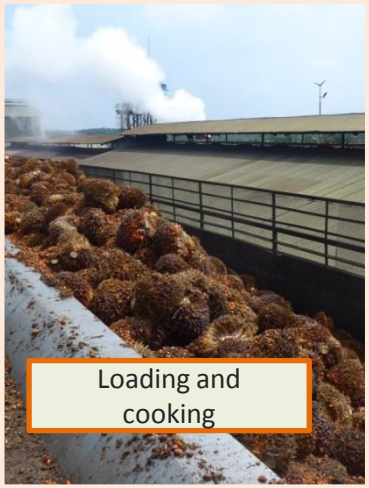
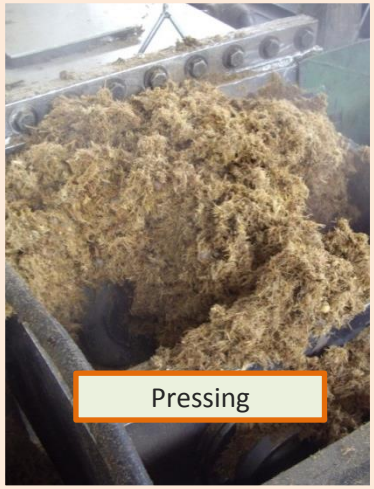
From the fruit to the oil





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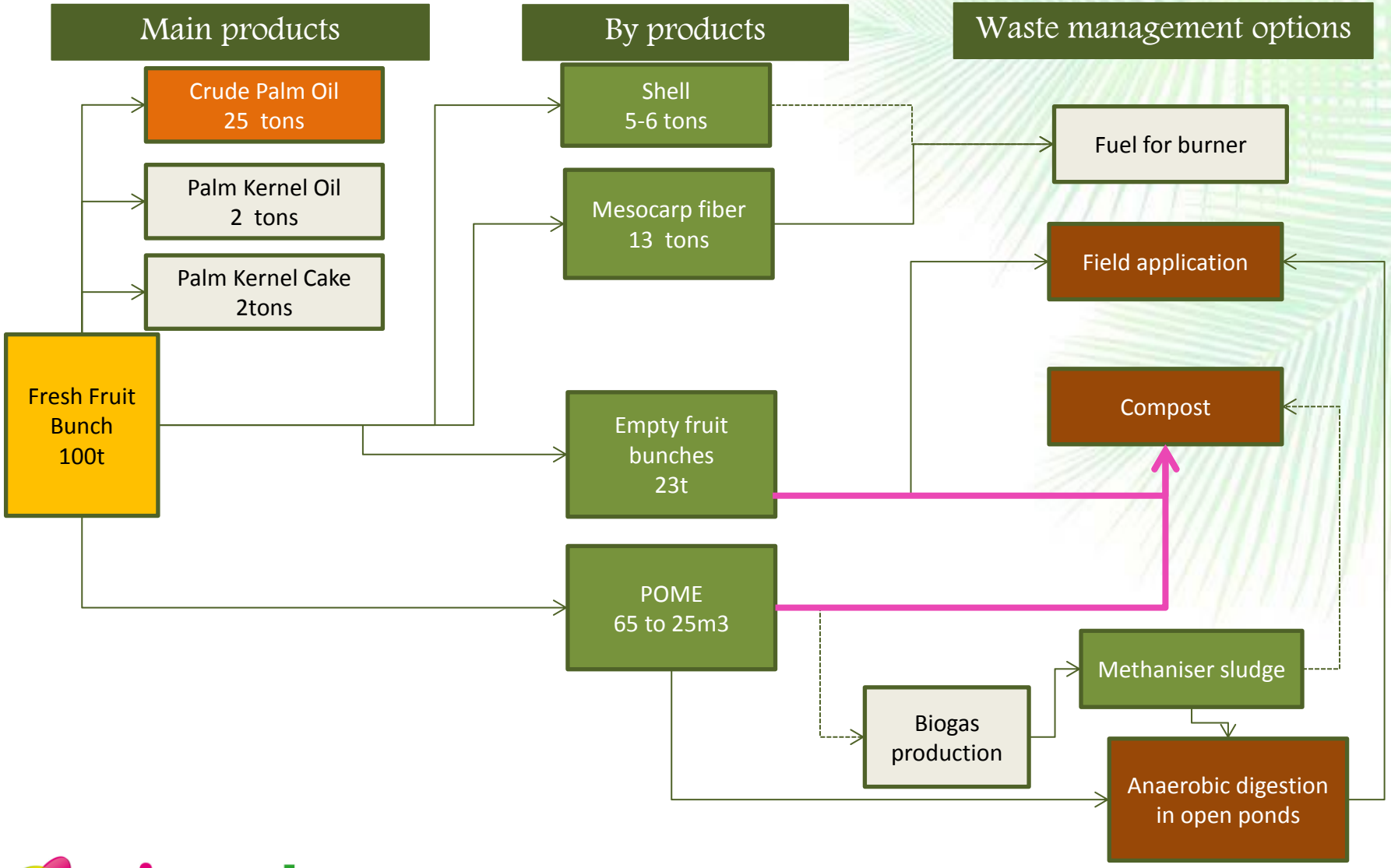
Palm oil co-products flow chart and waste management options



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Research question:

To which extent can composting be beneficial from an environmental point of view ?

EFB

POME

Need for site specific data to better understand our system

Implementation of a composting trial in industrial conditions

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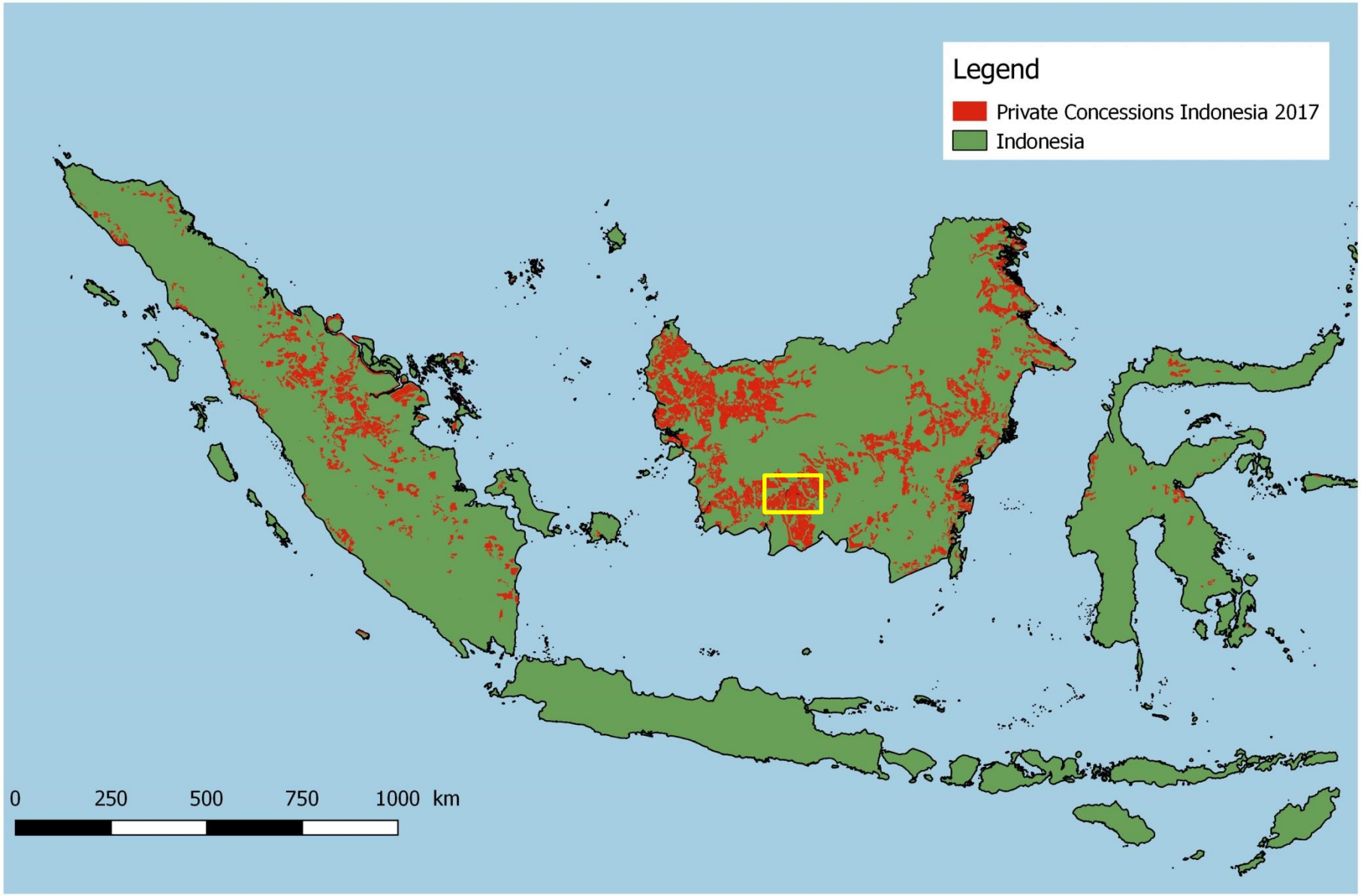
Legend
Private Concessions Indonesia 2017
Indonesia
0
250
500
750
1000 km

System studied

Agro-industrial oil palm plantation with a mill for crude palm oil production:

- One year case study (2017)
- 13 816 ha planted between 2006 and 2014
- 272 929 tons of fresh fruit bunches (average yield of 19,8tFFB/ha/year)
- One mill with capacity of 80t/hour
- 68 805 tons of crude palm oil (25,21% OER)

+/- 5 tons of CPO/ha

Unit for LCA : fresh fruit bunch (FFB) or **crude palm oil (CPO)**

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Industrial composting process

Composting is the **biological transformation of organic matter** carried out by a **succession of microbial** communities under **controlled environmental conditions.**

Composting platform

Fiberized EFB

Turning/spraying

Compost for application on mature palms

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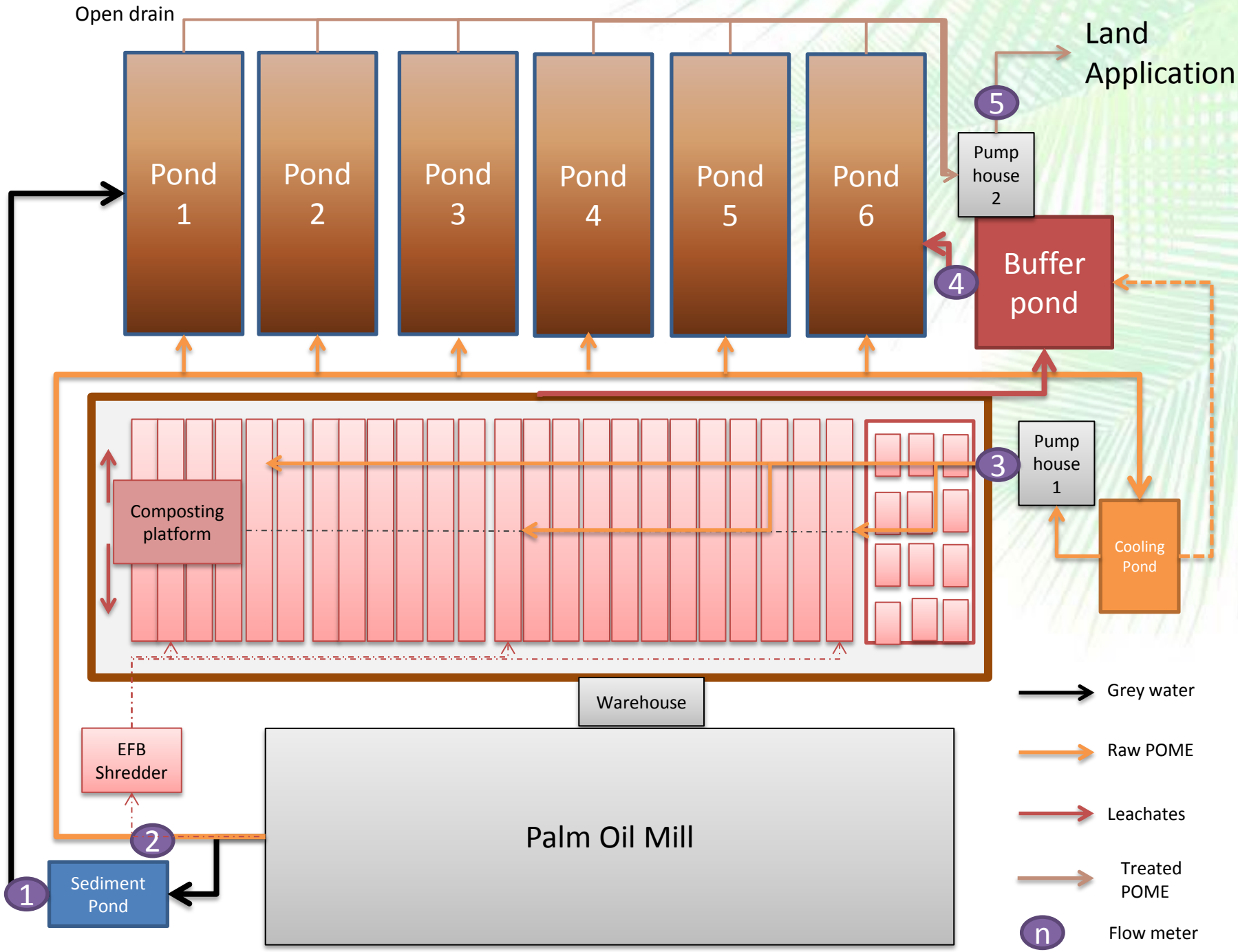

Open drain
Land Application
Pond 1
Pond 2
Pond 3
Pond 4
Pond 5
Pond 6
5
Pump house 2
4
Buffer pond
Composting platform
3
Pump house 1
Cooling Pond
Warehouse
EFB Shredder
Palm Oil Mill
2
1
Sediment Pond
Grey water
Raw POME
Leachates
Treated POME
n
Flow meter

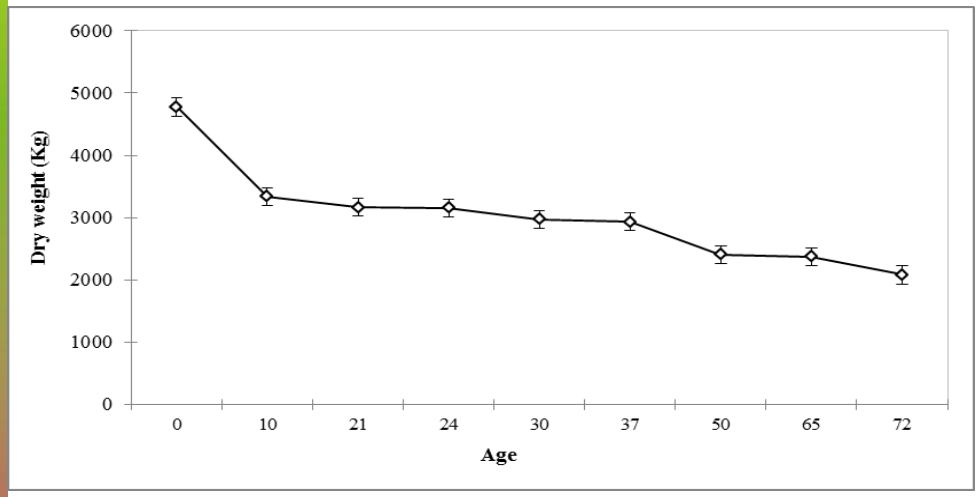
Compost production

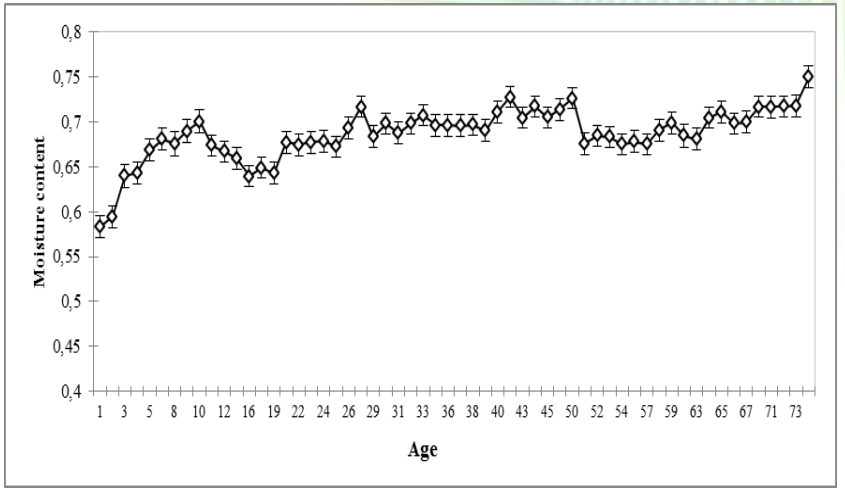
Energy and water consumption	Total Mill	Total Composting platform	Total per ton of CPO	Increase due to composting
Diesel Fuel (L)	422 032	105 175	8	25%
Electricity (kWH)	5 137 296	526 454	82	10%
Water Consumption (m3)	266 743	6 809	4	3%

31 482 tons (51 % FFB weight)

Final product: 75% water

Only 35% of POME treated aerobically





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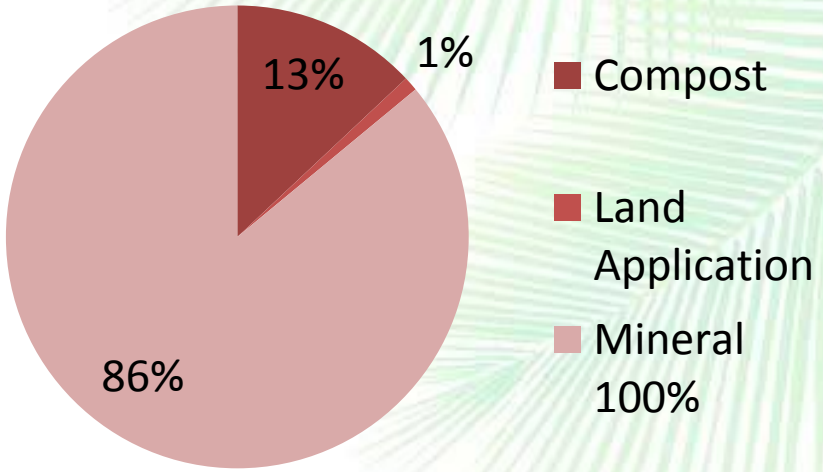
Compost as a fertilizer

Average dose (kg/ ha/year)	Mineral and compost	Mineral	Land application of effluent
Urea	12	234	-
DAP	0	200	-
RP	11	31	-
TSP	189	100	-
KCl	122	471	-
Dolomite	0	29	-
Kieserite	11	145	-
Borax	7	7	-
Compost	17595	-	-
Effluent (m3)	-	0	375



Compost saves 78% of fertilizers on 13% of the land area = 10 % saved

Dose applied = 130kg/palm or 17,5t/ha (fresh compost weight)

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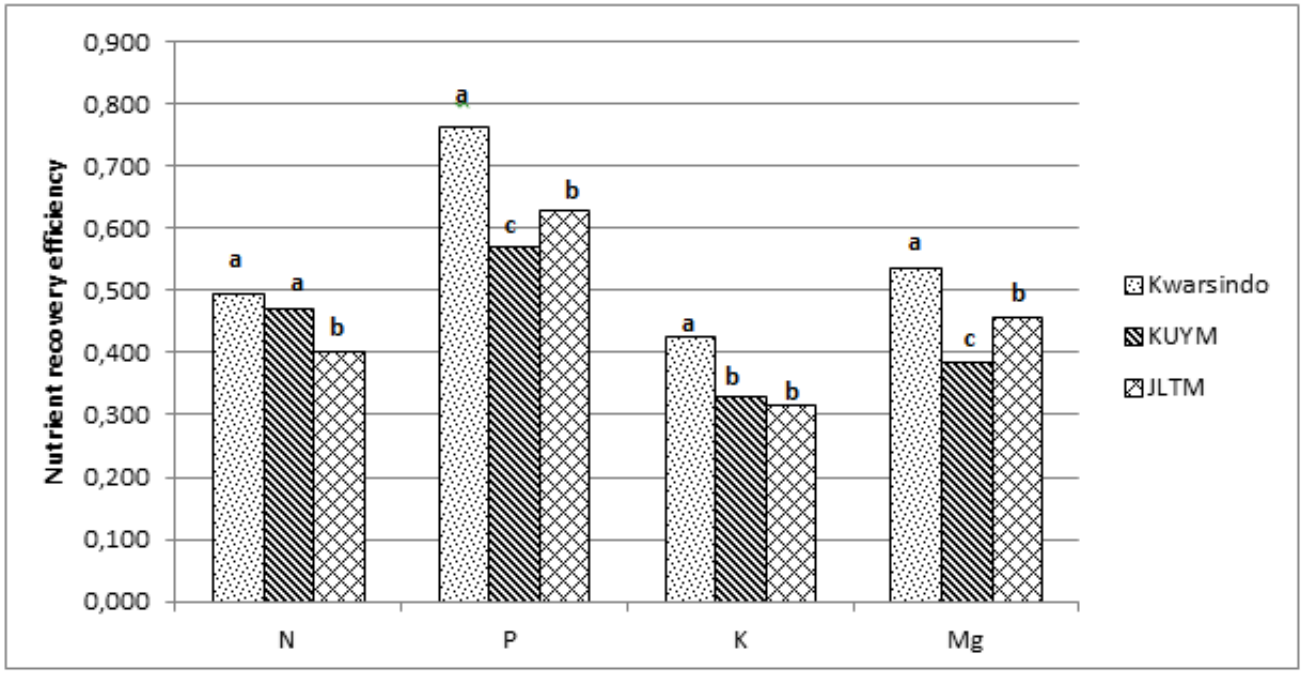
Compost quality and nutrient recovery efficiency



Fertilisations practices are linked to a low quality of compost resulting from excessive leaching in an open composting system.

Composting process	Additionnal Urea (2kg/ ton EFB)	Spraying and turning interval	Dose per spraying (L per ton of EFB)	Final POME/EFB ratio
1-JLTM	Yes	3	200	3.1
2-KUYM	No	1	100	4.9
3- KWAR	No	2	100	2.9

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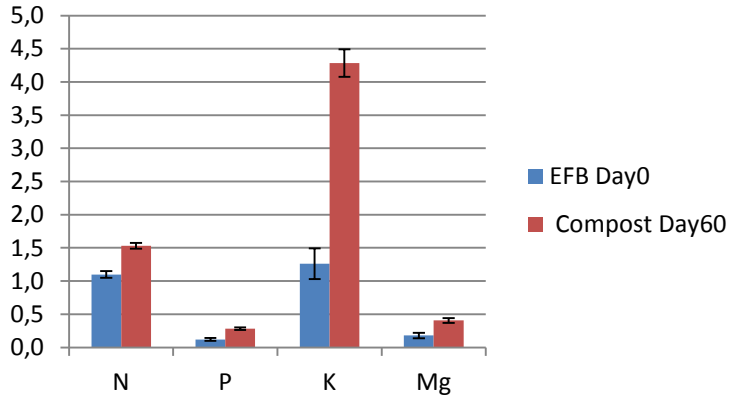
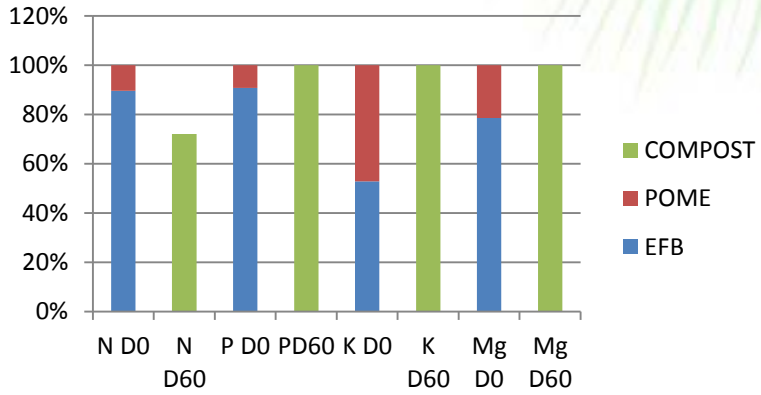
Roofing and recycling of the leachates will increase compost quality and nutrient recycling efficiency

Nutrient content



Nutrient recovery



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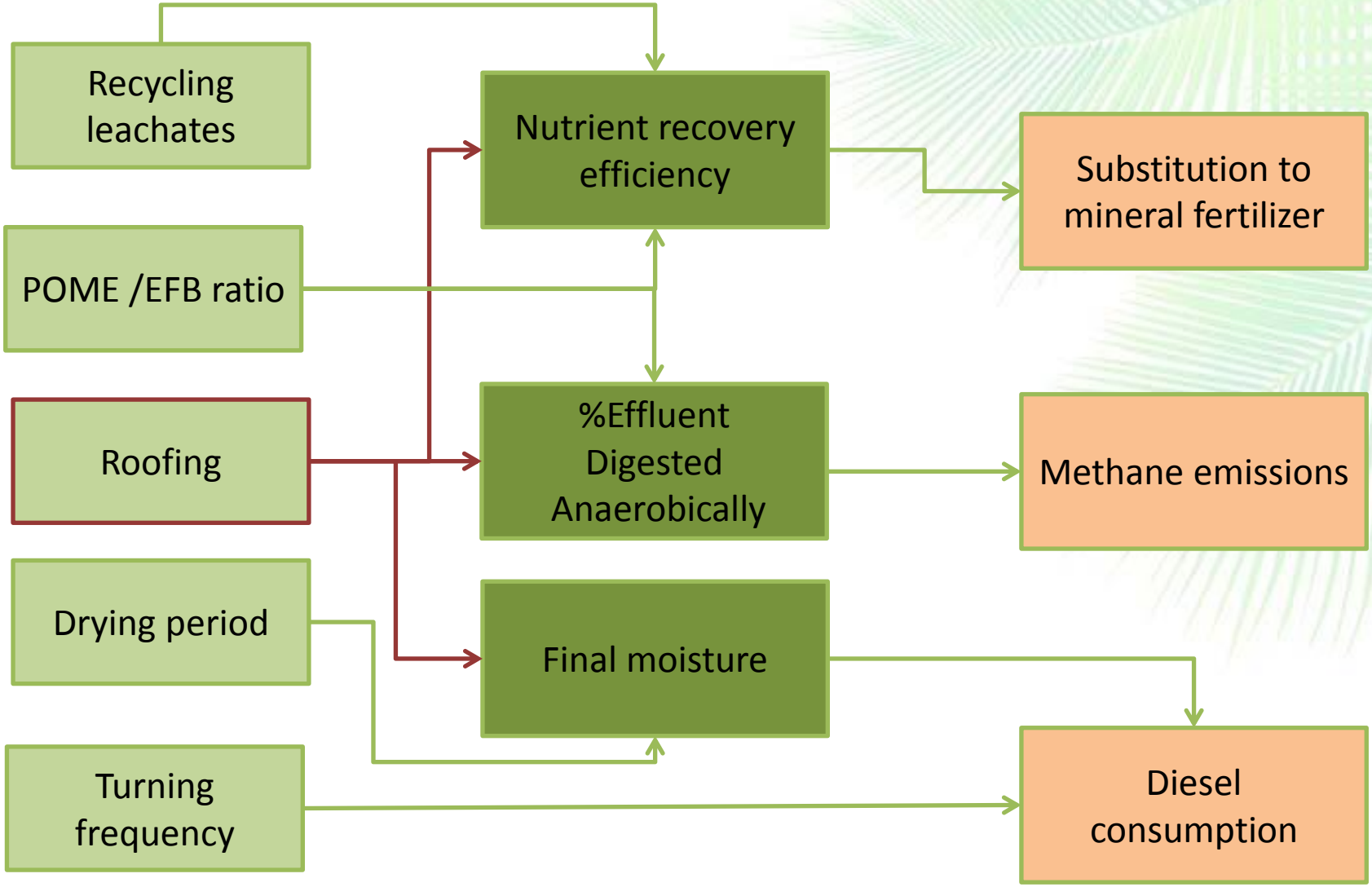
Critical point for LCA



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Thank You!

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